1980 HAMILTON

AIR QUALITY

Ministry
of the
Environment

Ontario

1980 HAMILTON AIR QUALITY

TECHNICAL SUPPORT SECTION

WEST CENTRAL REGION

JULY 1981

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SUMMARY

Air quality in Hamilton has improved significantly since 1970 in terms of long term averages for most monitored pollutants. The main concern continues to be particulate matter. Suspended particulate levels dropped most perceptively during the 1972-75 period and this improvement is attributable to the control programs instituted by the major industries in conjunction with the Ministry of the Environment. Since 1975 though, levels have remained relatively stable and are still unsatisfactory in a part of the city, especially near the heavy industry. However, the majority of the city does generally experience acceptable levels of suspended particulates. Soiling index showed a similar decline. However, dustfall levels have surprisingly shown no improvement at all during the 1970's and remain above objectives in a large part of the city.

In 1980, better weather conditions resulted in a general overall improvement in air quality. There were only five instances of the air pollution index reaching or exceeding 32, of which only 2 were of any significant duration. This follows the highly unusual events of 1979 when a series of lengthy and severe inversions helped create 22 such incidents.

Levels of sulphur dioxide, carbon monoxide and oxides of nitrogen remained acceptable in 1980 with all objectives met.

Levels of total reduced sulphur decreased sharply at the main station on Barton Street, probably due to the low number of inversions in 1980. In contrast, the North Park station on the Beach Strip showed a slight increase in levels.

The average of ozone levels increased marginally in 1980, but there were actually fewer hours above the objective than in 1979. Ozone, a secondary pollutant arising from photochemical reactions in the atmosphere is a regional problem and elevated levels above the objective have been recorded throughout Southern Ontario and the United States. Most of Southern Ontario's high levels seem to be caused by long range transport from the United States.

Sulphur and fluoride emissions stem mostly from industrial sources as indicated by sulphation and fluoridation rates, both of which continued to show elevated levels near the industrial area in 1980. There are no sulphation objectives but the levels appear to pose little problem and based on past phytotoxicology studies, it is improbable that the fluoride levels were high enough to cause vegetation damage.

INTRODUCTION

The Air Management Program in Ontario is based on controlling man-made emissions to meet ambient air quality objectives, which in turn are based on known effects on health, quality of life or sensititive vegetation, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is then used to verify that the controls have been successful. Monitors are mainly sited in areas suspected of experiencing higher levels of air pollution. If and when these areas achieve acceptable air quality, then other areas should also be acceptable.

Inventories of emissions from major pollution sources are maintained and can be used in mathematical modelling to predict pollutant concentrations at any given point in the atmosphere; however, more importantly, this inventory allows for an evaluation of the control programs and strategies through comparison of emissions to ambient air quality trends.

MONITORING NETWORK

The Ministry of the Environment operates a network of ambient air monitors throughout Hamilton as shown in Figure I. Monitoring is most concentrated in the lower city, that is, the area below the Niagara Escarpment and the network is centered on two major stations which monitor a variety of pollutants with mostly automated analyzers. The main station, known as 29025 - Barton/Sanford provides the data which forms the basis for the Hamilton Air Pollution Index (API). The other major station is on the Beach Strip and is known as 29008 - North Park, immediately adjacent to the Queen Elizabeth Way. The remainder of the network consists of numerous but mostly less sophisticated monitors. Most of the network has been in existence since at least 1970. Besides this regular network, special surveys are carried out occasionally in order to identify specific problems.

Meteorological data (wind speed and direction and temperature) are observed at station 29026, located on the sewage treatment plant grounds on Woodward Avenue. We consider this location to be more representative of local conditions than the Federal Government's Mount Hope Weather Station due to the complex meteorological patterns which sometimes prevail in Hamilton.

AIR POLLUTION INDEX

The Hamilton air pollution index (API) is used as a warning system to alert the public to elevated air pollutant levels. It is derived from 24 hour average concentrations of sulphur dioxide and particulate matter as measured at the Barton/Sanford Station. The combination of these two pollutants has been shown to be at least indicative of detrimental human health effects. No action is taken for readings up to 31. At 32, known as the advisory level, and with a forecast of unfavourable dispersion conditions, major emitters are notified and asked to voluntarily curtail certain operations. At an API of 50, cutbacks by these sources become mandatory. These levels are set with a considerable safety margin before health effects should take place.

The API station is located half-way between downtown and the heavy industry and is directly downwind of the industrial area during times of poorest atmospheric dispersion. Due to differences in station locations in relation to local sources, inter-city API comparisons are rather tenuous and therefore, caution must be exercised in their interpretation.

During 1980 there were five instances of the API reaching or exceeding 32 as listed in Table I. Of the five, three reached 32 for only three or four hours each. This is in direct contrast to 1979 when there were 22 separate incidents, some of long duration. The improvement was due to better weather conditions; there were far fewer temperature inversions in 1980.

The two major incidents occurred during the fall. The September 13 occurrence resulted during an extended period of light easterly winds off Lake Ontario and during October 16 - 17, a high pressure ridge stagnated over the area helping to create widespread elevated pollutant levels.

The three short incidents occurred during light easterly winds off the lake. Weather fronts quickly cleared the air each time.

PARTICULATES

There are three methods for the measurement of particles, each method relating to a different size range. Dustfall jars measure heavy material, generally greater than 10 microns in diameter. High volume samplers measure suspended particulates ranging in size from submicron to 50 microns and co-efficient of haze tape samplers measure mostly fine material - from submicron to about 10 microns.

The ambient air quality objectives for suspended particulate and soiling are based on health effects when occuring in combination with sulphur dioxide. As mentioned previously, this combination was proven to be indicative but not necessarily causative of such health effects. The dustfall objectives are based on nuisance effects.

Total Suspended Particulates

A high volume sampler draws a known volume of air through a pre-weighed filter for a 24 hours period (midnight to midnight). The exposed filter is weighed and the difference in conjunction with the known amount of air flow is expressed as concentration in micrograms per cubic meter. At two locations in Hamilton, these devices operate daily. At all other locations, they run on a once every six day cycle.

The Ministry Hi-vol network was expanded by two locations in 1980 and is now comprised of 13 instruments. The new monitors are located in the far east at Barton and Nash Road and in the west end at the Westdale Library to round out our coverage in the whole Hamilton area.

The suspended particulate concentrations (Table 2a) mostly show a slight decrease from 1979, probably due to the improved weather conditions in 1980.

McMaster University also continued Hi-vol sampling as part of their study on the health effects of air pollution. Their sampling co-incided with the Ministry sampling schedule, making their network of 14 Hi-vols a useful supplement to ours. The samplers are mostly situated in residential areas on the mountain and far ends of the city and most recorded very low concentrations, generally within objectives (Table 2b).

The large dual network makes it possible to draw a contour map of concentrations, given in Figure 2. It can be seen that the majority of the city meets the yearly objective of 60 ug/m^3. In fact, the area within this contour exceeding the objective is 36 square kilometers, which is only 29% of the area within city boundaries. Concentrations are only elevated close to the industrial area plus in a small pocket of light manufacturing near Main Street and Highway 403.

The effect of urban activity on suspended particulate concentrations is illustrated by three monitors in the downtown area. All three are in the same general area with respect to the industrial area, but show widely different results. The Hi-Vol on the roof of City Hall (29007) approximately 200 feet above ground, had a geometric mean of 59 ug/m^3 while only a short distance away near the intersection of James and Hunter (29001), the mean was 71 ug/m^3. This monitor on the roof of the Regional Health Unit is only 30 feet above ground. The difference in concentration between the two stations is probably accounted for by proximity to road traffic. Another short distance away is the Aberdeen monitor whose mean was only 45 ug/m^3, well below the objective. This Hi-Vol is in a residential area set off from major roadways and the heavy activity of the business district.

A similar observation is noted in the east end of the city. The Hi-Vol on the roof of the Ministry of Environment office on Centennial Parkway showed a mean of 60 ug/m^3 while in a residential area on Pottruff Road, the mean was only 39 ug/m^3. Again, the difference would seem related to road traffic.

Soiling Index (Co-efficient of Haze)

Coefficient of haze tape samplers operate continuously and can determine hourly or two-hour average soiling values. Air is drawn through a filter paper and the optical density of the soiled spot is measured by light transmittance. Unfortunately, the one-hour telemetered instruments have been demonstrated to yield values at least 25% higher than the two-hour instrument for equal samples of air and hence, the two types of measurement are not directly comparable. Due to this unresolved difference, the two-hour data are presented separately from the one-hour data.

The main stations on Barton Street and North Park both employ one-hour instruments (Table 3a). North Park again showed a high average well above the yearly objective, similar to 1979 with 81 days above the daily objective. Barton Street showed a marked improvement from 1979 levels and its average fell to only slightly above the yearly objective, similar to 1975-78 with 20 days above the daily objective. The improvement was probably due to fewer inversion conditions. The North Park station showed no improvement probably because it is mainly influenced by the frequency of southwest winds which predominate in this area and which continued to do so in 1980. The station is downwind of the Industrial Area, but is also immediately adjacent to the heavy traffic on the Q.E.W. which will have a substantial impact on the concentrations.

Six other stations in the lower city employ two-hour instruments and all recorded low averages well below the yearly objective (Table 3b). Most showed a small decrease in levels similar to the Barton Street station and there was only a single day above the daily objective at one location

Dustfall

Dustfall is that material which settles out of the atmosphere by gravity and is collected in plastic containers during a 30 day exposure time. The collected material is weighed and expressed as a deposition rate of grams/square meter/ 30 days. The significance of observations is restricted to relatively local areas.

Dustfall levels in 1980 (Table 4) remained similar to those of previous years. Figure 3 depicts dustfall isopleths and shows that a portion of the lower city and the Beach Strip near the industrial area was encompassed by the 9.0 grams/m^2/ 30 days contour which represents twice our objective. Conditions in this area, for the most part were quite poor, however, the area is relatively small - only about 15 square kilometers. Only one station on the mountain recorded a mean below the yearly objective of 4.5 grams. The contour of this concentration showed that it encompasses approximately 57 square kilometers or about 46% of the city. Dustfall levels throughout the city have remained virtually unchanged throughout the 1970's; a puzzling observation considering the considerable reductions in industrial process emissions and the correspondingly large reductions in soiling index and suspended particulate concentrations noted in Figure 4. Fugitive dust sources such as uncontrolled stock piles, excavation and construction, road dust, open lots susceptible to wind erosion, etc. may be important in explaining this observation.

SULPHUR DIOXIDE

Most sulphur dioxide (SO_2) emissions in Hamilton, as detailed by the emissions inventory, stem from industrial sources. Only a small portion is accounted for by fuel burning in domestic space heating. The Barton/Sanford and North Park stations monitor SO_2 continuously and data is summarized in Table 5.

Sulphur dioxide trends from the two stations since 1970 are illustrated in Figure 5. In 1980, as in the past several years, the concentrations were acceptable, within the yearly objective and there were no readings above the hourly objective. These objectives are based on vegetation damage; a more stringent limitation than human health effects.

TOTAL REDUCED SULPHUR

This pollutant was formerly identified as hydrogen sulphide (H_2S). However, since the analyzer also reacts to other sulphur compounds, the data is now referred to as total reduced sulphur. The objective for hydrogen sulphide may still be applied to the observed values and is based on the odour threshold level. Both Barton/Sanford and North Park monitor continuously and the data are summarized in Table 6.

The major sources of hydrogen sulphide and related sulphur compounds are the steel industry's coke ovens, certain slag reclamation processes and under upset conditions, a local manufacturer of carbon black. Another potential but rather minor source is Windermere Basin. Sulphur bearing organic sediments from Red Hill Creek and sewage overflow from the sewage treatment plant may during the spring, under certain adverse conditions, decompose and produce hydrogen sulphide. The sewage treatment plant itself is another minor source, but only during certain upset conditions when similar undesirable decompositions of sewage can occur.

Yearly trends for the two stations are illustrated in Figure 6. During 1976-79, both monitors showed a trend to increasing levels. In 1980, the Barton average decreased greatly and showed far fewer exceedences of the hourly H_2S objective. The improvement was probably weather related. Conversely, North Park levels continued to increase and showed

on average double the concentrations of Barton. There were only 26 hours above the objective, the same as Barton, but this was far more than recorded in previous years at North Park. The cause of the increase may be partly due to meteorological conditions but has not been totally determined.

CARBON MONOXIDE

The major source of carbon monoxide emissions is the automobile. However, in Hamilton there are also some contributions from industry. Due probably mainly to automotive emission controls, the levels measured at Barton Street (Table 7) decreased greatly over the 1970-80 period (Figure 7). In 1980, the levels decreased slightly further and were well below the objectives which are based on health effects.

OXIDES OF NITROGEN

The primary source of oxides of nitrogen are high temperature combustion sources. The most abundant oxides are nitric oxide (NO) and nitrogen dioxide (NO_2) and they are monitored continuously at both Barton/Sanford and North Park. At each station, a single instrument makes measurements of NO, NO_2 and total nitrogen oxides. Nitric oxide is measured directly and the total oxides are measured by internally converting all other nitrogen oxides to nitric oxide. The instrument then determines nitrogen dioxide to be the difference between the first two measurements.

Of the three reported pollutants, objectives exist only for nitrogen dioxide and these are based on odour threshold levels and health effects.

Data for oxides and nitrogen are given in Tables 8 - 10 and yearly trends since 1975 are illustrated in Figures 10 - 12. The nitrogen dioxide objectives were never exceeded in 1980 (Table 8) and since 1977, all three pollutants have shown a trend to decreasing concentrations.

Similar to previous data, NO_2 levels were similar at the two stations, but NO levels were about three times as high at North Park than at Barton. This is probably explained by North Park's close proximity to the QEW. Most vehicular emissions of oxides of nitrogen consist of NO which later is oxidized to NO_2 in the atmosphere. The North Park station probably monitors the NO before this conversion can fully take place.

Oxides of nitrogen are an important factor in the photochemical production of ozone which will be discussed later in this report.

OZONE

Oxidants are mainly a product of photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight. Ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive.

Ozone is known to be associated with many respiratory problems and at elevated concentrations, people can experience adverse health effects. Ozone is also injurious to different types of vegetation including certain tobacco and tomato crops. The one-hour objective for ozone (.08 ppm) is based on both health and vegetation effects.

Ozone concentrations follow very definite annual and daily trends. Highest levels occur during the summer (May - September) and the daily maximums usually occur during mid-afternoon. Both patterns are directly related to the amount and intensity of sunlight.

Ozone is measured at the Barton Street station and data is summarized in Table II, while yearly trends are illustrated in Figure 8.

The 1980 average showed a slight increase. However, there were fewer exceedences of the hourly objective than in 1979 - only 24 in May to July. These higher concentrations were widespread, occurring concurrently throughout Southern Ontario during periods of southerly or southwesterly winds which implies their origin to be in the United States.

Ozone, hydrocarbons and oxides of nitrogen can be transported over great distances and be augmented by local sources. However, Hamilton and other major urban areas usually experience lower ozone concentration than their more rural surroundings during peak occurences. In fact, the concentrations in Hamilton are among the lowest recorded in Southern Ontario, probably due to the numerous high temperature combustion sources which produce higher levels of nitric oxide, a scavenger of ozone. Nonetheless, ozone and other oxidants remain a problem which, due to the complexity of their formation and the long range transport phenomenon, will have to be resolved on a regional rather than local scale.

SULPHATION

Sulphation rate is a crude measurement used to determine relative quantities of various sulphur compounds in the ambient air. A paper coated with lead peroxide is exposed to the atmosphere for approximately 30 days and then chemically analysed for sulphur. The results are reported as depositions of sulphur trioxide. Initially, a sulphation objective existed and was based on the sulphur dioxide yearly goal. However, the correlation between sulphation rate and sulphur dioxide depends on the type and number of different compounds involved and because of this variability, the sulphation objective was dropped in 1979. As well, in 1979 a change in methodology was made by substituting "plates" for "candles". The change was made for reasons of economy and ease of analysis. However, it has been established from side by side exposures, that plates read on the average about 30% higher.

Although the measurement is crude, it is useful for trend determination purposes as well as detecting severe pollution problems which call for more sophisticated instrumentation.

Keeping in mind the change in methodology, the concentrations in 1980 were reduced at most locations from 1979 and were probably similar to 1978 levels. The improvement was probably weather related.

As to be expected, levels were highest in the industrial area but fell off quickly with distance indicating sulphurous gases are not much of a problem to most of the city.

FLUORIDATION

This measure is a crude assessment similar to that for sulphation. A lime coated paper is exposed to the atmosphere for approximately 30 days and is then chemically analyzed for fluoride. The fluoride objectives are based on vegetation damage and for this reason, the objective is more stringent during the growing season. For the period of April 15 to October 15, it is 40 micrograms/100 square centimeters/30 days while for the remainder of the year it is 80.

In Hamilton, the major fluoride sources are the basic oxygen furnaces used by the major steel industries which require fluorspar as a fluxing

agent. In addition to these process emissions, there are other minor sources such as coal burning since coal contains trace amounts of fluoride.

Data for 1980 is summarized in Table 13 and the yearly trend since 1970 is illustrated in Figure 9.

The trend graph shows that levels have remained relatively stable since 1974 following large reductions in concentrations which began in 1971.

In 1980, consistently elevated concentrations continued to be observed on the Beach Strip (29058) and at Burlington/Gage (29059) near the main fluoride sources. Most of the rest of the stations showed only occasional and marginal exceedences of the objectives. Based on past vegetation studies, it is unlikely that even the highest concentrations affected local plant life.

DISCUSSION

Due to improved weather conditions in 1980, concentrations of most pollutants showed a decrease from 1979 levels. Nevertheless, the city remains susceptible to short periods of elevated pollutant levels during inversion conditions.

Most gaseous pollutants are under control, however, dust particles remained elevated in the vicinity of the industrial area. Industrial emissions were reduced significantly from 1970 to 1975 and moderately since then. The finer measured particles, as characterized by suspended particulate and soiling index, show a similar trend. In contrast, the heavier, settleable material known as dustfall, quite surprisingly, has shown no improvement at all since 1970. This seems to indicate that apart from the remaining process emissions, other pollution sources on which no emphasis has yet been placed, will require control. These sources can be both industrial and non-industrial in nature such as blowoff from unpaved areas, excavation, construction, demolition, road traffic, uncontrolled stock piles and other non-stack industrial emissions.

Preliminary results of a study by independent researchers, indicates that the contributions from industrial sources to long term average particulate concentrations are relatively minor and other (fugitive) sources are the major causes.

In 1980, further control orders were issued to the major steel industries. Implementation of the orders will extend into 1983. Emphasis will be placed on further reducing emissions from coke ovens, blast furnaces and steel making furnaces through the upgrading and repair of some of the current facilities.

RESEARCH STUDIES

A study by the Ontario Research Foundation funded by the Federal and Provincial Governments as well as industry, has been completed, pending a final report. It is aimed at identifying the type and origin of dust particles in Hamilton's air, including the effect of road dust and its re-entrainment by wind and traffic. The basis for the study is the fact that during recent years, improvements in air quality have not been proportional to abatement efforts by government and industry. It appears that there is a limit to further air quality improvements which can be achieved through control of traditional sources, and that abatement measures which could be undertaken are becoming increasingly costly and decreasingly efficient. The study is expected to result in sound scientific information on the proportion of air pollution attributable to industrial and non-industrial sources and will determine the best cost-effective control strategies.

Also, McMaster University is carrying out a three year provincially and federally funded study which will attempt to determine by extensive breathing tests, the respiratory health of 3,800 Hamilton school children and will relate these data to air quality measurements. The project will also inter-relate other factors, such as indoor environment, which may affect the children's respiratory health. Results of the study will provide evidence in establishing sound criteria, standards and indices for ambient air quality based on actual health effects.

ACKNOWLEDGEMENT

We would like to thank Mr. Stephen A. Toplack of the Urban Air Environment Group at McMaster University for providing their suspended particulate data.

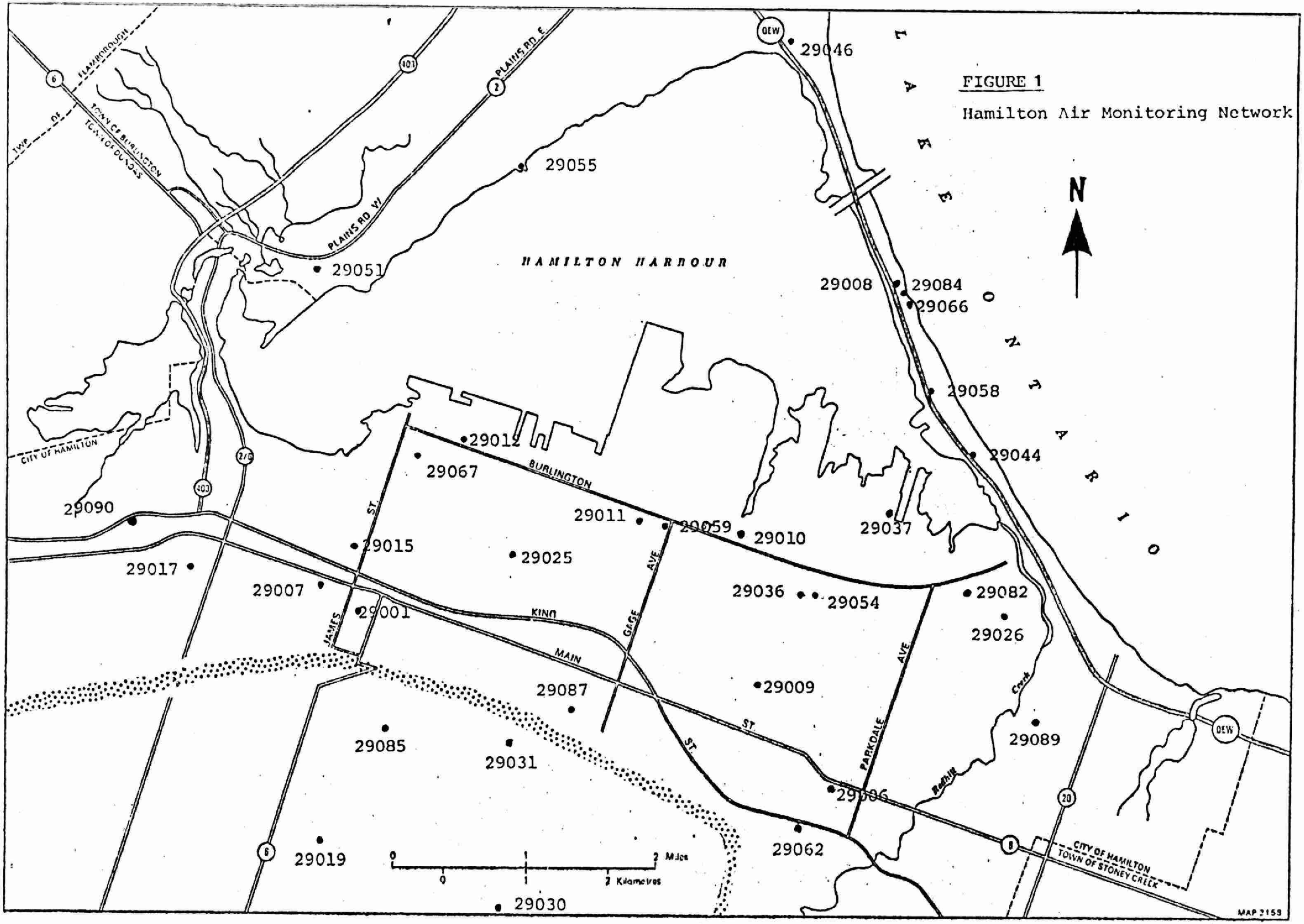


FIGURE 1

Hamilton Air Monitoring Network

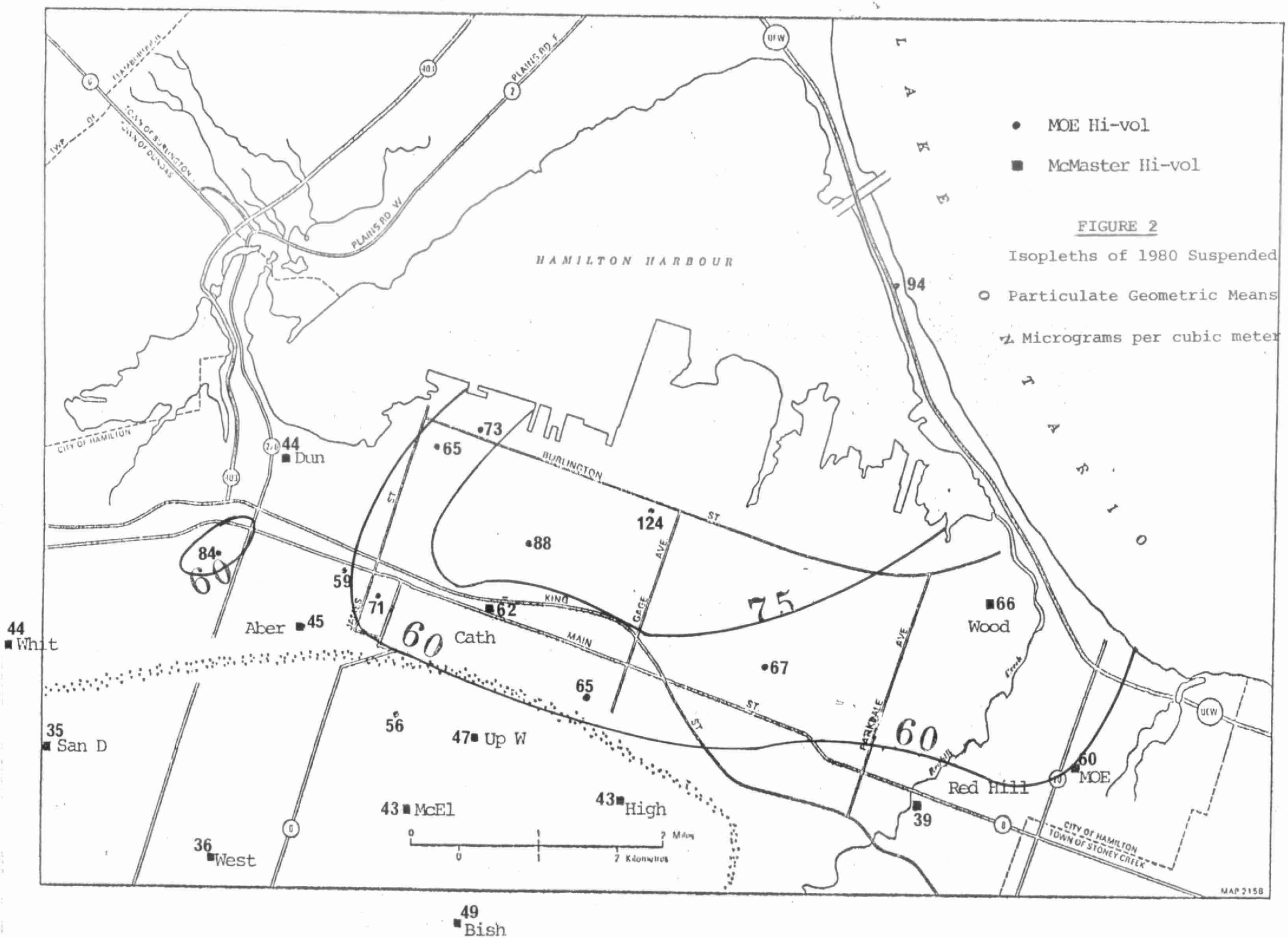


FIGURE 2

Isopleths of 1980 Suspended Particulate Geometric Means in Micrograms per cubic meter

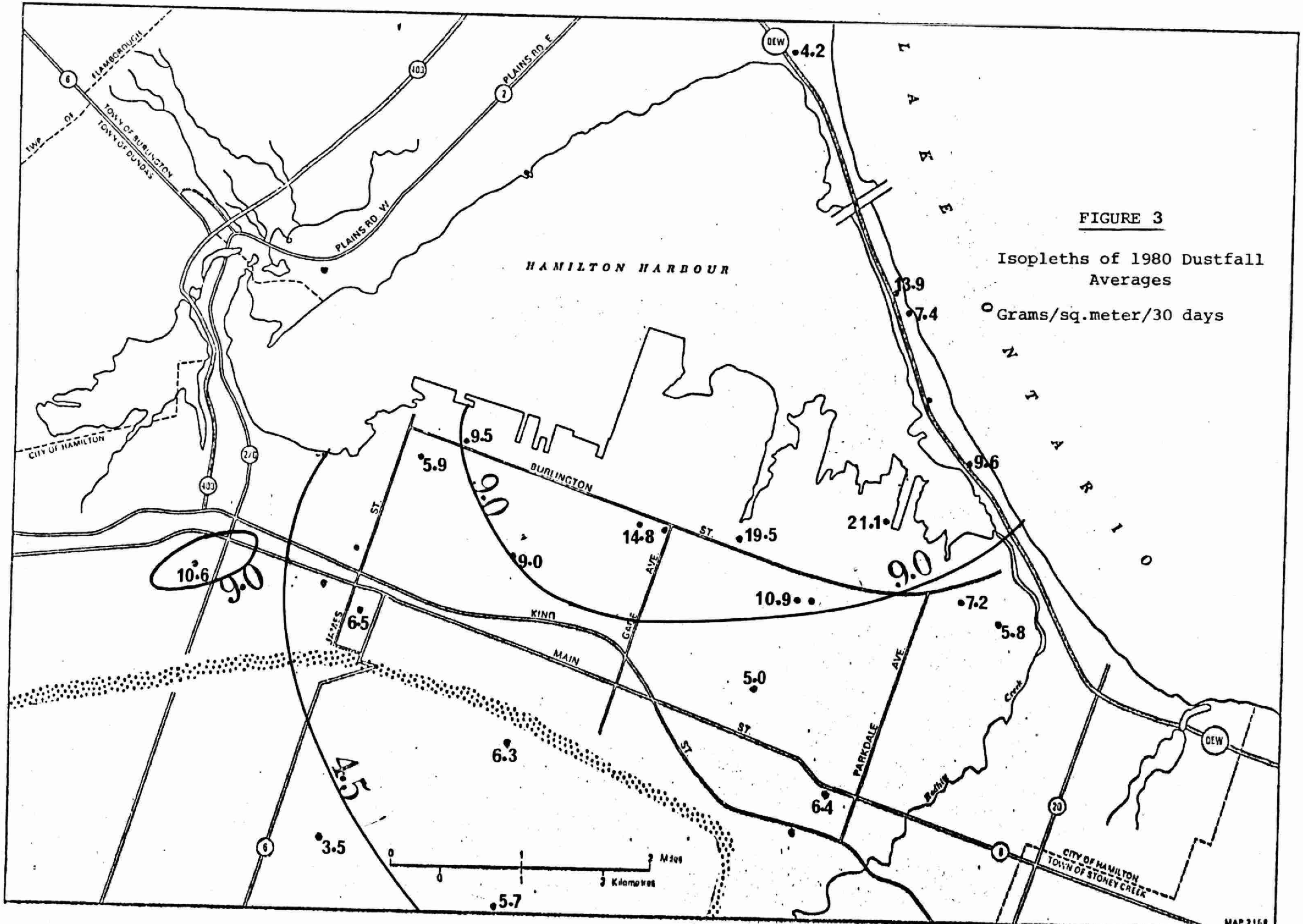


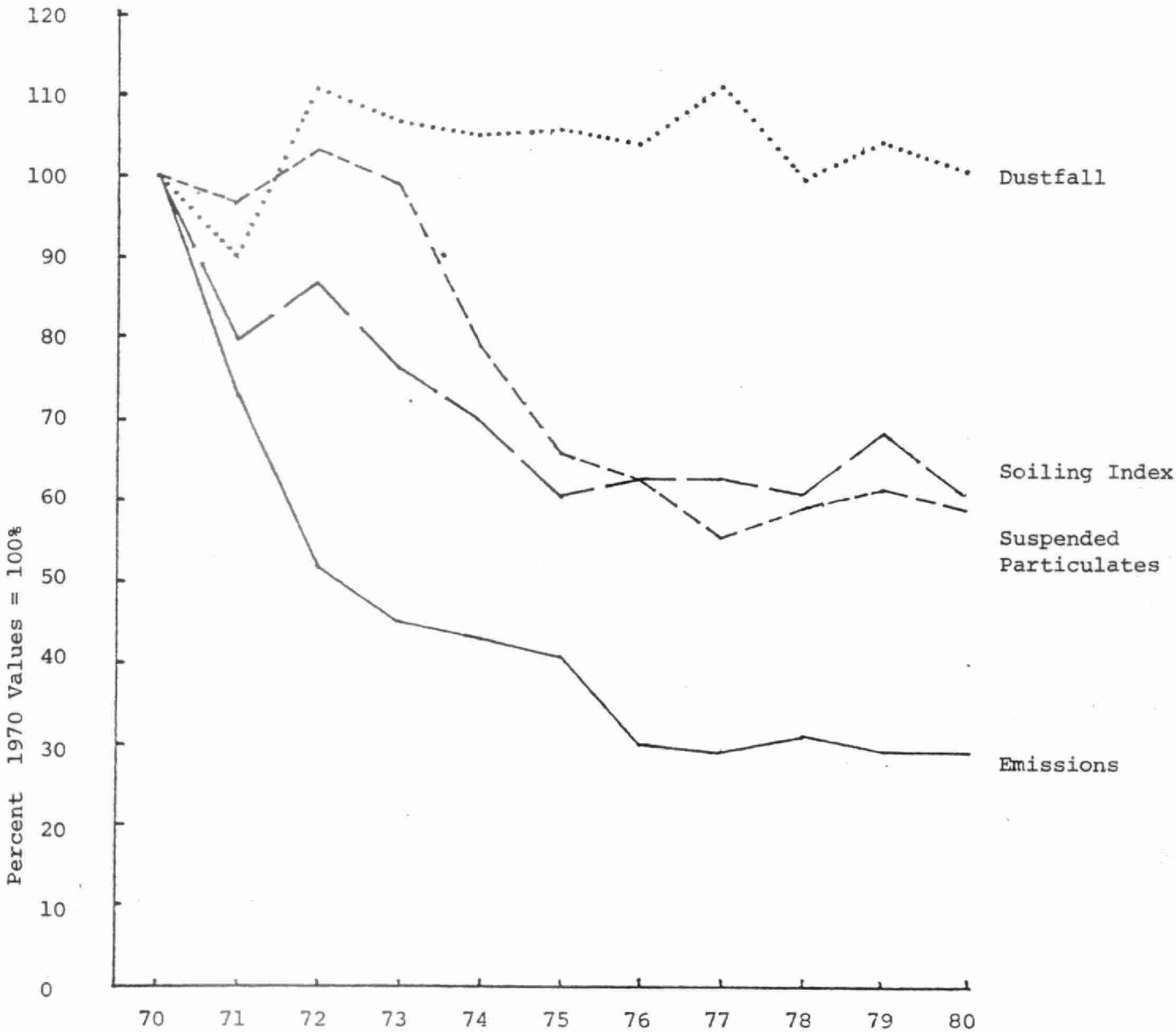
FIGURE 3

Isopleths of 1980 Dustfall Averages

Grams/sq.meter/30 days

FIGURE 4

Particulate Trends vs Estimated Emissions



	70	71	72	73	74	75	76	77	78	79	80	
Suspended Particulate (7 stations)	131	127	135	130	104	86	83	73	77	81	77	ug/m^3
Dustfall (17 stations)	9.4	8.5	10.4	10.1	9.9	10.0	9.8	10.4	9.4	9.8	9.5	g/m^2/30 days
Soiling Index (7 stations)	.54	.43	.47	.41	.38	.33	.34	.34	.33	.37	.33	COH's/1000ft
Institutional & Industrial Emissions	56	41	29	25	24	23	17	16	17.5	16	16	10^6 lbs/year

Yearly Trends of Pollutants

FIGURE 5

Sulphur Dioxide

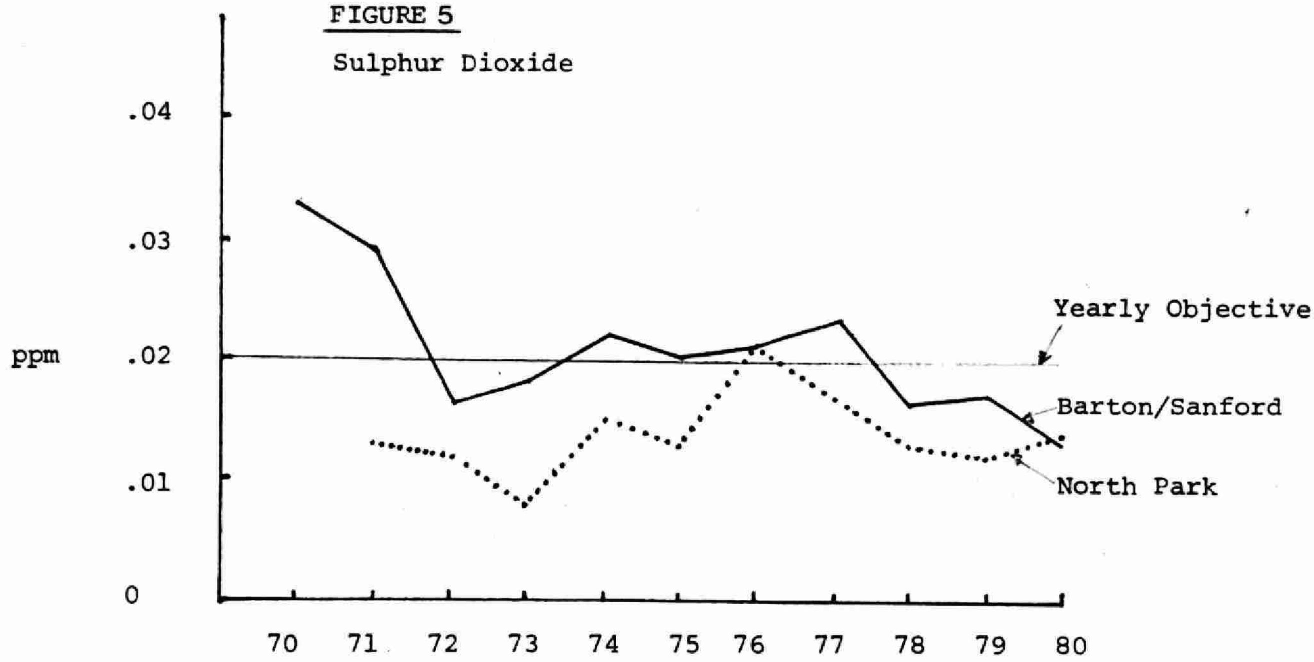
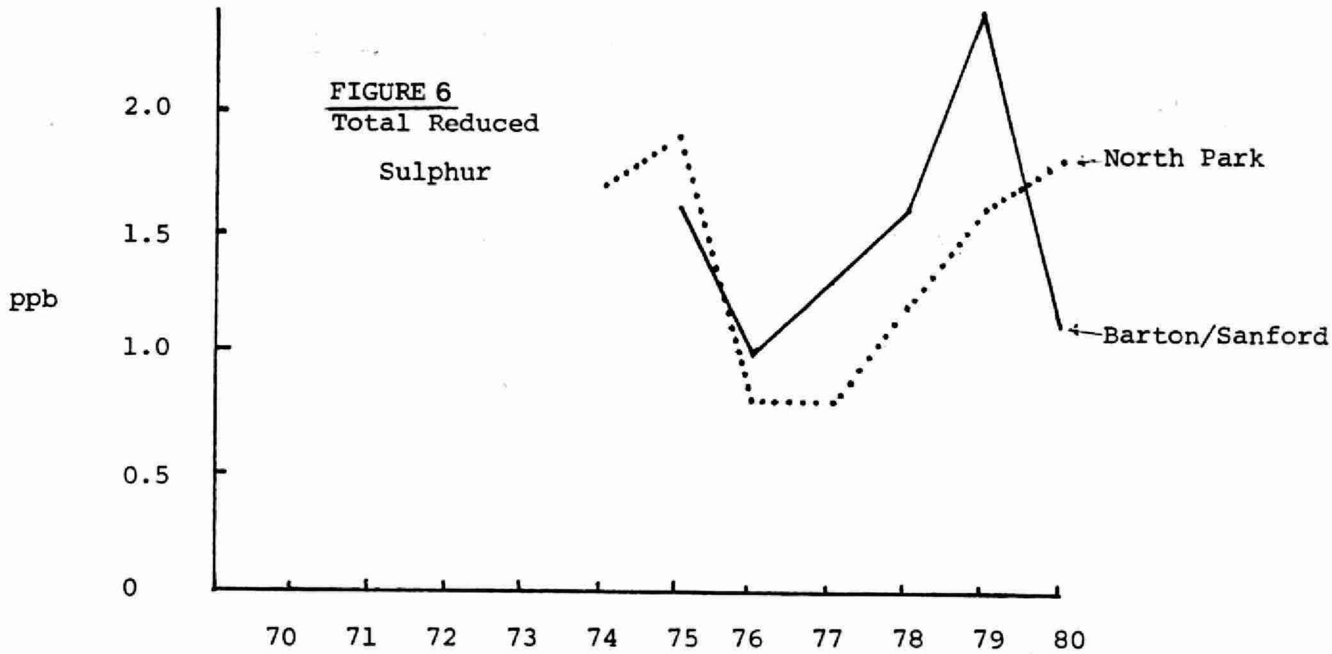


FIGURE 6

Total Reduced Sulphur



Yearly Trends of Pollutants

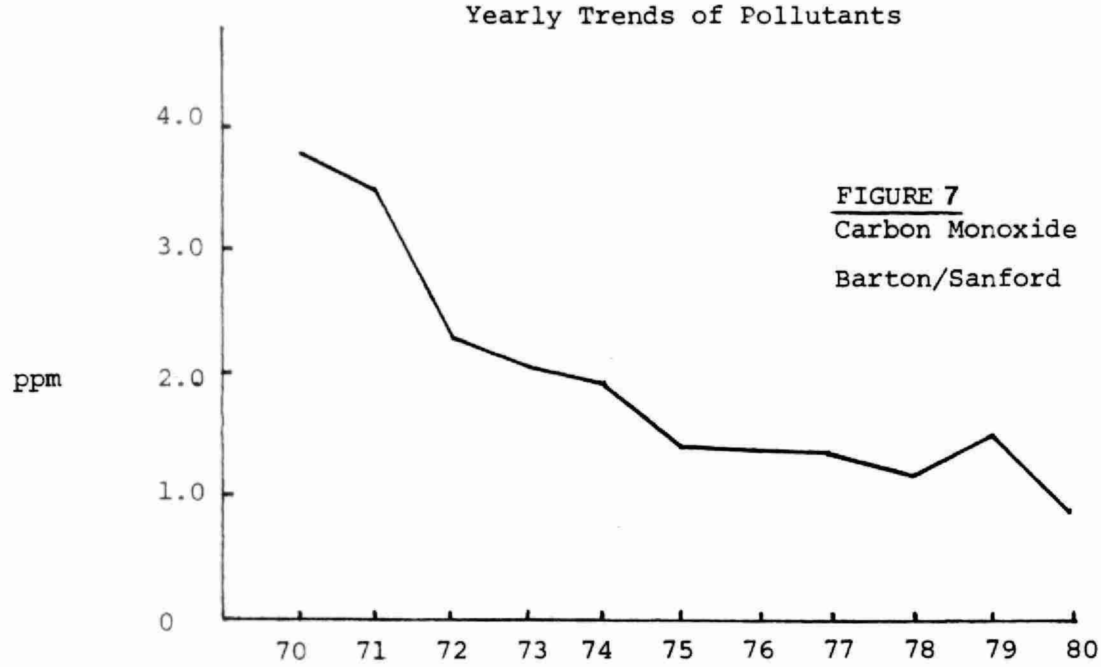


FIGURE 7
Carbon Monoxide
Barton/Sanford

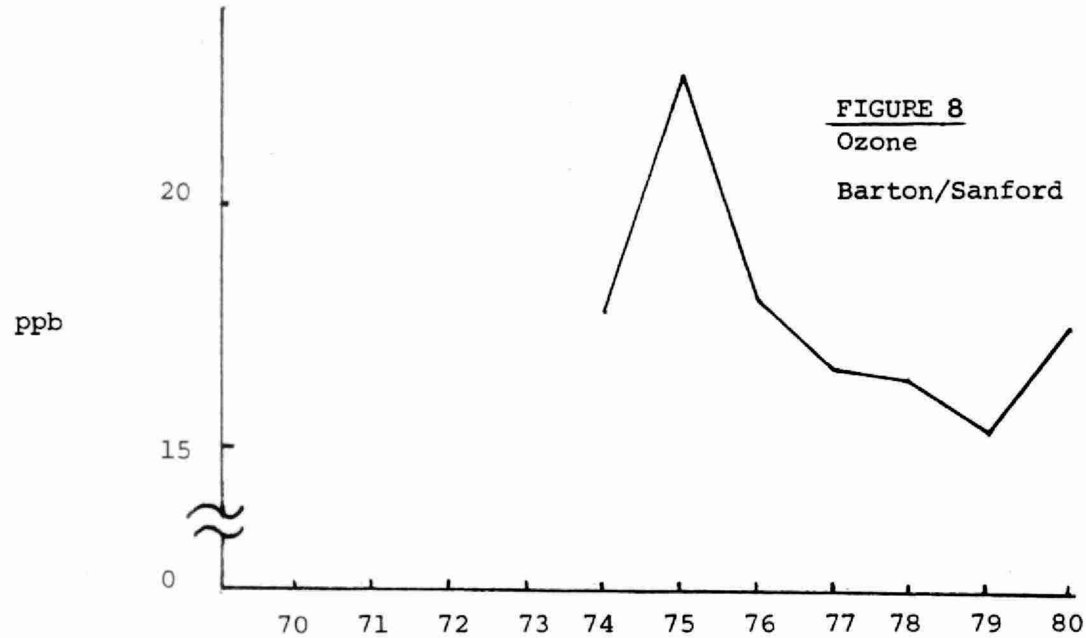


FIGURE 8
Ozone
Barton/Sanford

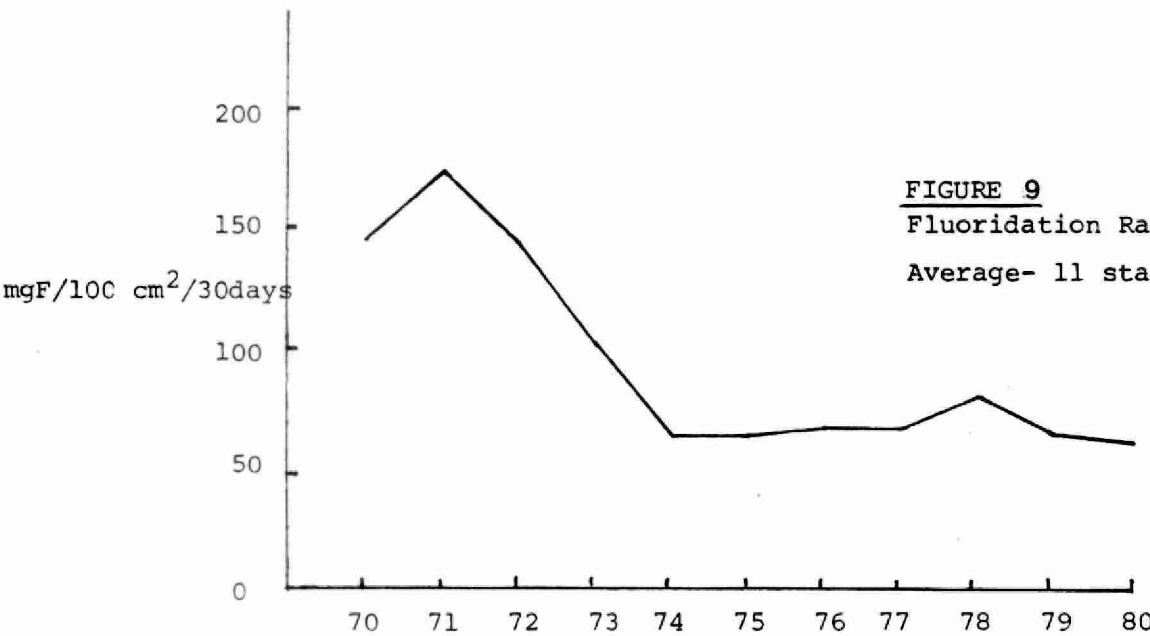
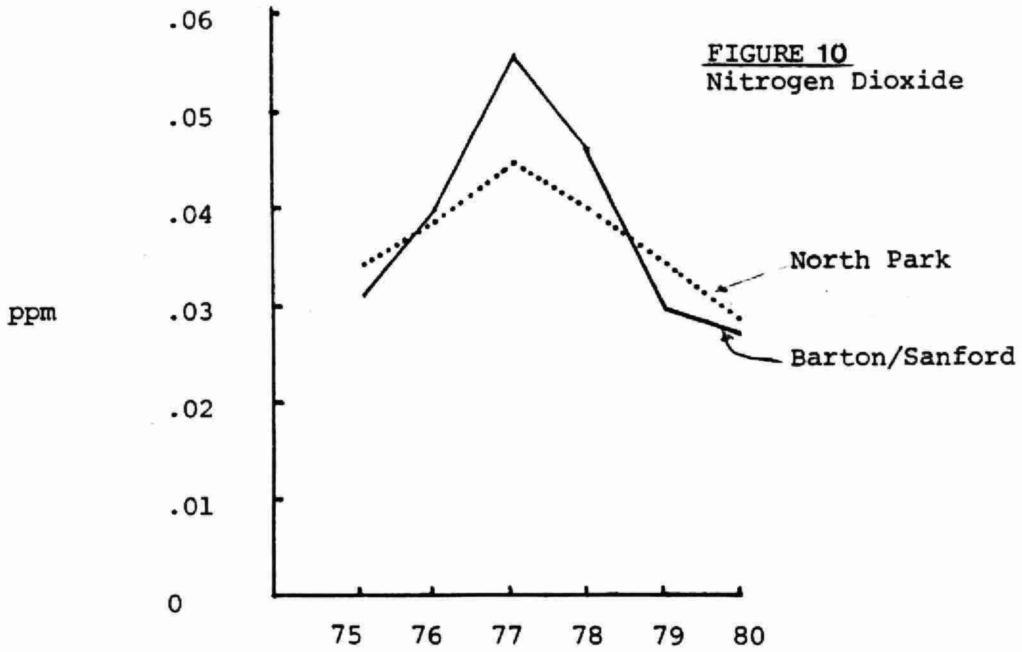
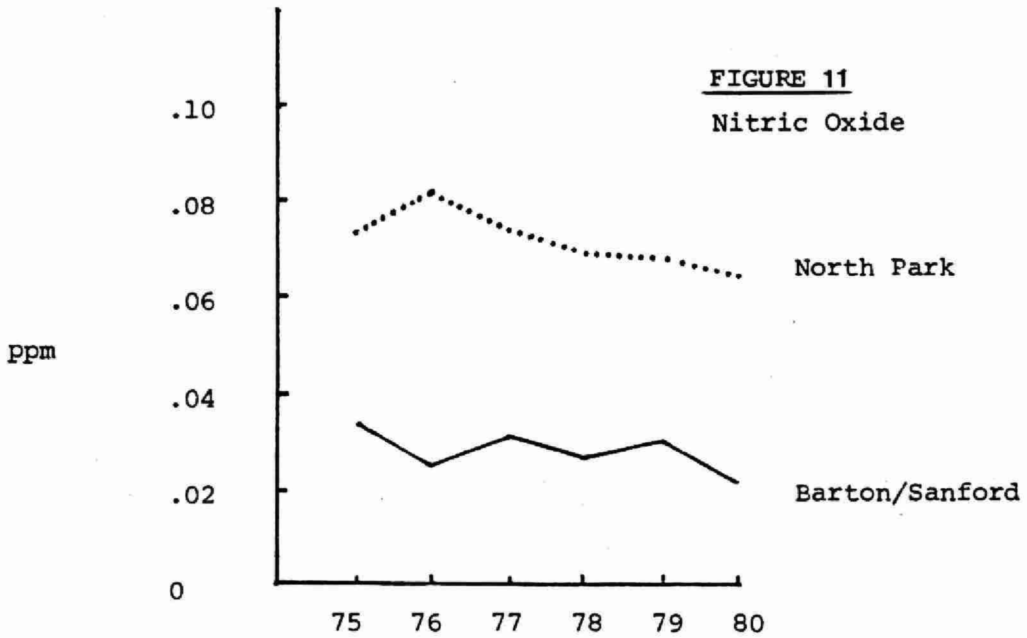


FIGURE 9
Fluoridation Rate
Average- 11 stations

Yearly Trends of Pollutants





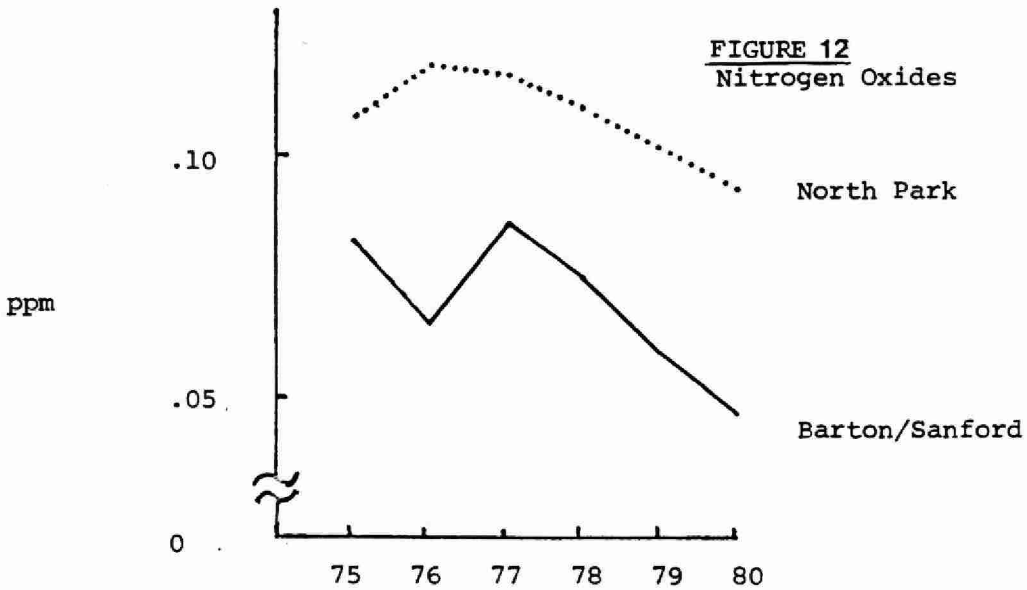


TABLE I

AIR POLLUTION INDEX - 1980

OCCASIONS WHEN 32 OR ABOVE

	Date	Maximum	No. of Hours ≥ 32
1	April 7	32	4
2	April 23	32	3
3	September 13	39	22
4	October 16-17	40	39
5	December 28	32	3

TABLE 2a

SUSPENDED PARTICULATES - 1980

UNITS - MICROGRAMS PER CUBIC METER

ONTARIO OBJECTIVES: 24-hour - 120
1-year Geo. Mean - 60

	No. of Samples	Geometric Mean 1980	1979	1978	Maximum	No. of Times Above 120
29001 - Hughson/Hunter	58	71	78	64	199	6
29007 - City Hall	58	59	60	61	185	4
29008 - North Park	342	95	96	93	348	126
29009 - Kenilworth	59	67	69	70	172	9
29011 - Burlington-Leeds	57	124	120	133	336	30
29012 - Burlington-Wellington	54	73	76	74	195	7
29017 - Chatham-Frid	55	84	91	77	198	10
29025 - Barton-Sanford	326	88	100	102	326	88
29067 - 450 Hughson St. N.	57	65	62	63	218	4
29085 - Mountain Police Station	59	56	61[9]	-	168	2
29087 - Cumberland	58	65	73[9]	-	178	4
29089 - Barton/Nash	43	70[9]	-	-	182	3
29090 - Westdale Library	23	67[5]	-	-	138	1

TABLE 2b

McMASTER UNIVERSITY SAMPLING - 1980

SUSPENDED PARTICULATES

MICROGRAMS PER CUBIC METER

ONTARIO OBJECTIVES: 24-hour average - 120
1-year Geo. Mean - 60

LOCATION	No. of Samples	Geometric Mean 1980	Geometric Mean 1979	Maximum	No. of Times Over 120
San Diego Court	51	35	47	89	0
Upper Ottawa/Mohawk	52	36	44	89	0
Aberdeen/Undermount	58	45	51	156	2
Whitney/Rifle Range	47	44	55	128	1
Potruff/Queenston	55	39	52	111	0
McElroy/Upper Wellington	60	43	55	159	1
Queensdale/Green Meadow	55	43	-	120	0
Upper Wentworth/ Queensdale	43	47	-	154	3
Main/Wentworth	56	62	-	167	7
Westmount	57	36	-	127	1
Bishopgate/Ranchdale	52	49	-	229	4
Dundurn Castle	58	44	-	111	0
Centennial Pkwy./ Violet Drive	56	60	-	134	1
Woodward/Brampton	55	66	-	153	3

TABLE 3a

SOILING INDEX - 1980

1-HOUR TELEMETERED INSTRUMENTS

UNITS - COH's per 1000 linear ft. of air

Ontario Objectives - 24-hour - 1.0
1-year - 0.5

	Annual Average 1980	1979	1978	1977	Maximum 24-hour	No. of Times Above Objective 24-hour
29008 - North Park	.72	.73	.67	.63	1.9	81
29025 - Barton/Sanford	.54	.63	.56	.54	1.6	20

1-hour telemetered data not directly comparable to 2-hour data - see text

TABLE 3b

SOILING INDEX - 1980

2-HOUR INSTRUMENTS

UNITS - COH's per 1000 linear feet of air

Ontario Objectives - 24-hour - 1.0
1-year - 0.5

	Annual Average 1980	1979	1978	1977	Maximum 24-Hour	No. of Times Above Objective 24-Hour
29001 - Hughson/Hunter	.23	.32	.25	.20	0.8	0
29009 - Kenilworth	.19	.18	.15	.20	0.6	0
29012 - Burlington/ Wellington	.20	.18	.16	.26	2.0	1
29015 - Merrick/James	.24	.28	.28	.26	0.9	0
29017 - Chatham/Frid	.22	.29	.25	.20	0.8	0
29067 - 450 Hughson N.	.20	.24	.23	.22	0.7	0

2-hour data not directly comparable to 1-hour telemetry data - see text

TABLE 4

DUSTFALL 1980

UNITS - GRAMS/SQ. METRE/30 DAYS

Ontario Objectives - 1 month avg - 7.0
1 year avg - 4.5

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average 1980	1979	1978
29001 Hughson/Hunter	6.8	5.7	10.3	9.5	8.1	6.1	5.8	5.7	4.7	5.3	4.1	6.0	6.5	7.5	6.5
29006 Queenston	8.3	5.7	10.5	9.6	7.0	5.6	5.8	5.6	4.4	4.5	4.2	5.1	6.4	6.2	8.0
29008 North Park	18.1	13.0	16.7	9.3	11.3	12.5	14.2	11.4	10.5	14.5	13.3	21.8	13.9	13.8	12.6[11]
29009 Kenilworth	5.9	5.1	6.4	6.5	6.8	5.2	3.2	5.2	4.3	3.3	3.9	4.8	5.1	5.9	6.1
29010 Burlington/Ottawa	18.1	18.3	25.4	26.6	-	16.9	15.3	18.2	16.5	18.3	22.4	18.3	19.5[11]	17.4[4]	14.4[9]
29011 Burlington/Leeds	17.4	14.5	23.5	17.9	-	12.4	11.4	12.4	13.4	11.8	12.8	15.3	14.8[11]	16.3	14.9[11]
29012 Burlington/ Wellington	14.1	8.2	14.3	10.6	10.9	9.5	7.2	7.2	7.8	6.9	7.9	9.9	9.5	8.8[10]	10.4
29017 Chatham/Frid	16.0	10.4	12.7	8.8	10.1	8.1	10.7	9.4	8.8	12.0	9.2	10.8	10.6	9.5	10.6
29019 Mohawk/Warren	2.4	2.8	5.3	3.9	4.9	4.0	3.3	1.8	4.3	3.6	2.6	3.1	3.5	4.5	4.2[11]
29025 Barton/Sanford	8.0	6.3	14.7	13.3	11.4	8.1	7.0	7.3	9.3	8.7	7.5	5.9	9.0	10.7[10]	9.5
29026 Woodward/Brampton	6.7	6.4	5.9	4.3	10.3	6.6	4.6	4.4	4.6	4.1	5.0	6.6	5.8	5.3	5.0
29030 Camden/Mohawk	4.5	5.3	5.7	5.1	9.6	6.4	7.7	6.3	5.7	3.8	4.4	3.8	5.7	5.0	6.3
29031 Concession/ Upper Sherman	8.1	7.1	8.4	7.3	7.6	5.6	4.4	5.0	5.7	6.2	4.4	6.2	6.3	8.0	7.5

Underlined values are above objective

TABLE 4 (Cont'd)

DUSTFALL 1980

UNITS - GRAMS/SQ. METRE/30 DAYS

Ontario Objectives - 1 month avg - 7.0
1 year avg - 4.5

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average 1980	Average 1979	Average 1978
29036 Roosevelt/Beach Rd.	8.2	8.6	12.3	10.1	9.6	10.6	10.0	8.6	8.0	7.9	8.3	28.1	10.9	14.7	10.6
29037 Strathearn	23.0	17.0	27.9	27.2	19.8	28.1	17.3	17.6	11.7	21.0	34.1	8.5	21.1	24.8	16.1
29044 Wark/Beach Blvd.	14.8	10.0	14.6	8.9	9.3	9.8	10.5	6.5	8.0	8.1	6.9	8.1	9.6	11.7	11.6
29046 O.P.P. Bldg Burlington	3.6	2.9	3.3	4.1	16.2	2.3	5.4	2.8	2.9	1.9	1.9	2.9	4.2	4.8	6.7
29067 450 Hughson N.	7.4	5.2	11.5	5.9	9.0	5.5	4.2	2.4	5.0	5.4	4.7	4.9	5.9	6.1	5.8
29082 Leaside Rd.	8.3	6.4	7.4	5.4	7.3	12.3	8.0	7.2	6.1	7.1	5.2	6.2	7.2	8.5	7.7
29084 Rembe/Beach Blvd.	-	7.9	7.7	5.4	5.9	13.3	7.4	6.9	6.2	5.8	8.0	7.3	7.4[11]	6.4[11]	-

- Underlined values are above objective

TABLE 5

SULPHUR DIOXIDE

UNITS - PARTS PER MILLION

Ontario Objectives: 1-hour - .25
24-hour - .10
1-year - .02

		Annual Average	Maximum 1-hour	Maximum 24-hour	No. of Times Above Objective 1-hour	No. of Times Above Objective 24-hour
29008 - North Park	1980	.014	.13	.07	0	0
	1979	.012	.14	.08	0	0
	1978	.013	.13	.07	0	0
	1977	.017	.15	.08	0	0
29025 - Barton/ Sanford	1980	.013	.16	.06	0	0
	1979	.017	.25	.10	0	0
	1978	.016	.29	.07	1	0
	1977	.023	.17	.08	0	0

TABLE 6

TOTAL REDUCED SULPHUR

UNITS - PARTS PER BILLION

Ontario Objective: 1-hour - 20 (Hydrogen Sulphide)

		Annual Average	Maximum	No. of Times Above Objective
29008 - North Park	1980	1.8	44	26
	1979	1.6	32	3
	1978	1.2	36	5
	1977	0.8	26	2
29025 - Barton/ Sanford	1980	0.9	61	26
	1979	2.4	144	75
	1978	1.6	66	74
	1977	1.3	110	65

TABLE 7

CARBON MONOXIDE

UNITS - PARTS PER MILLION

Ontario Objective: 1-hour - 30
8-hour - 13

		Annual Average	Maximum 1-hour	Maximum 8-hour	No. of Times Above Objective 1-hour	No. of Times Above Objective 8-hour
29025 - Barton/Sanford	1980	0.9	10	4	0	0
	1979	1.5	14	9	0	0
	1978	1.2	9	5	0	0
	1977	1.4	12	7	0	0

TABLE 8

NITROGEN DIOXIDE

UNITS - PARTS PER MILLION

Ontario Objectives: 1-hour - .20
24-hour - .10

		Annual Average	Maximum		No. of Times Above Objective	
			1-hour	24-hour	1-hour	24-hour
29008 - North Park	1980	.028	.15	.10	0	0
	1979	.034	.16	.10	0	0
	1978	.040	.14	.11	0	1
	1977	.045	.20	.14	0	3
29025 Barton/Sanford	1980	.027	.15	.06	0	0
	1979	.029	.12	.07	0	0
	1978	.046	.18	.12	0	3
	1977	.057	.18	.13	0	2

TABLE 9

NITRIC OXIDE

UNITS - PARTS PER MILLION

		Annual Average	Maximum 1-hour	Maximum 24-hour
29008 - North Park	1980	.065	.52	.16
	1979	.068	1.00	.23
	1978	.069	.69	.24
	1977	.073	.71	.34
29025 - Barton/Sanford	1980	.021	.43	.13
	1979	.030	.78	.43
	1978	.026	.60	.15
	1977	.030	.55	.26

TABLE 10

NITROGEN OXIDES
(Sum of Nitrogen Dioxide and Nitric Oxide)

UNITS - PARTS PER MILLION

			Maximum	
		Annual Average	1-hour	24-hour
29008 - North Park	1980	.093	.55	.21
	1979	.101	1.04	.30
	1978	.110	.76	.30
	1977	.117	.77	.40
29025 - Barton/Sanford	1980	.046[10]	.34	.12
	1979	.059	.88	.50
	1978	.073	.64	.22
	1977	.086	.63	.36

TABLE 11

OZONE

UNITS - PARTS PER BILLION

Ontario Objective: 1-hour - 80

		Annual Average	Maximum	No. of Times Above Objective
29025 - Barton/Sanford	1980	17.4	107	24
	1979	15.3	112	32
	1978	16.3	119	71
	1977	16.6	92	15

TABLE 12

SULPHATION RATE - 1980

MILLIGRAMS $SO_3/100\ CM^2/DAY$

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average 1980	Average 1979*	Average 1978
29001 Hughson/Hunter	.40	.45	.89	1.05	.29	.42	.24	.45	.36	.27	1.05	-	.57[11]	.58	.48
29006 Queenston	.36	.41	.74	.23	.17	.29	.22	.85	.40	-	.62	-	.43[10]	.44	.37[11]
29008 North Park	.55	1.18	1.09	.52	.53	.67	.57	.84	.81	1.45	2.58	-	.98[11]	1.04	.89
29009 Kenilworth	.38	.52	.58	.23	.28	.34	.30	.25	.38	.31	.67	-	.38[11]	.54	.46
29010 Burlington/Ottawa	.54	.70	1.24	.87	.59	.66	.74	.84	.93	.75	.89	-	.80[11]	-	1.00[9]
29011 Burlington/Leeds	.25	.20	1.55	1.05	.77	.71	.52	.73	.85	1.52	.76	-	.81[11]	1.15[20]	.75
29012 Burlington/ Wellington	-	.25	.84	.74	.33	.30	.26	.32	.51	.33	.76	-	.46[10]	.52[10]	.50
29017 Chatham/Frid	.38	.60	1.32	.52	.60	.34	.34	.53	1.22	.30	1.04	-	.65[11]	.79	.51
29019 Mohawk/Warren	.41	-	1.54	.49	.32	.37	.29	.33	.63	.40	.54	-	.53[10]	.80	.46
29025 Barton/Sanford	.33	.36	1.55	.89	.51	.37	.26	.47	.56	.48	.73	-	.59[11]	.76[9]	.52
29026 Woodward/Brampton	.51	.54	.68	.42	.39	.52	.44	.29	.70	.37	.48	-	.49[11]	.50	.48
29030 Mohawk/Camden	.37	.42	1.04	.42	.38	.30	.29	.21	.39	.30	1.43	-	.50[11]	.74[11]	.40
29031 Concession/ Upper Sherman	.57	.67	1.85	.92	.44	.59	.37	.53	.65	.33	.15	-	.64[11]	.76	.51
29036 Roosevelt/Beach Rd.	.92	.70	1.40	.38	.50	.44	.49	.71	.50	.49	-	-	.65[10]	.85[11]	.66

* Switched to "plates" - see text

TABLE 12 (Cont'd)

SULPHATION RATE - 1980

MILLIGRAMS SO_3/100 CM^2/DAY

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average 1980	Average 1979	Average 1978
29037 Strathearn	-	.92	2.17	.92	1.10	-	.82	.88	1.10	1.08	1.02	-	1.11[9]	1.50	.78
29044 Wark/Beach Blvd.	.93	.56	-	.56	.55	.48	.49	.36	.66	.83	.23	-	.57[10]	.66	.57
29046 OPP Building Burlington	-	.24	.36	.15	.18	.20	.18	.13	.33	.15	1.35	-	.33[10]	.29[10]	.32[11]
29051 Botanical Gardens Burlington	.28	.30	.53	.23	.20	-	.39	.23	.19	.32	1.13	-	.38[10]	.33	.48
29055 LaSalle Park Burlington	.40	.36	.44	.17	.21	-	.20	.19	.27	.15	.28	-	.27[10]	.38[11]	.41
29067 450 Hughson N.	.41	.30	.44	.38	.26	.27	-	.38	.30	.16	.89	-	.38[10]	.33	.35

*Switched to "plates" - see text

TABLE 13

FLUORIDATION RATE - 1980

ALL VALUES IN MICROGRAMS/100 SQ.CM/30 DAYS

Ontario Criteria: April 15 to October 15 - 40
October 16 to April 14 - 80

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average 1980	Average 1979	Average 1978
29001 Hughson/Hunter	12	9	44	51	64	39	26	36	28	13	16	-	31[11]	43	41
29008 North Park	123	40	77	86	39	19	86	87	138	173	140	176	99	76	116[11]
29012 Burlington/ Wellington	-	15	60	47	46	34	24	28	32	22	28	36	35[11]	37[10]	43
29017 Chatham/Frid	28	18	51	81	46	39	41	52	21	28	26	30	38	49	51
29025 Barton/Sanford	15	15	86	65	44	39	24	43	19	21	20	24	35	60	52
29026 Woodward/Brampton	29	20	44	17	29	27	35	32	49	32	48	36	33	46	53
29054 Beach Rd./Conrad	40	46	69	44	48	52	61	45	66	43	82	61	55	71	70
29058 Q.E.W./Skyway	134	85	129	121	164	101	80	161	162	207	144	126	135	131	170
29059 Burlington/Gage	72	70	125	104	118	90	142	82	140	88	95	114	103	93	137[10]
29062 Briarwood School King St. E.	67	39	91	31	67	82	62	50	44	73	48	62	60	71[10]	68
29066 Killarney/Beach B.	92	42	59	61	51	32	62	54	62	122	86	118	70	68	110[11]

- Underlined values are above objective

Date Due
